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RMR Technical Memo #1106

USER MANUAL
ISAR6 and DAQ4 System on the R/V MIRAI

October 1, 2011

Left: ISAR6 mounted on the foremast. Right: The DAQ4 remote unit (RU).

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1 System Description

The Infrared Sea Surface Temperature Autonomous Radiometer (ISAR) (description on page 6) was developed at Southampton Oceanographic Center and Brookhaven National Laboratory approximately ten years ago [*Donlon et al.*, 2008] for the purpose of providing data for satellite validation and for algorithm development.

This manual describes an installation for the JAMSTEC R/V MIRAI which includes a second-generation ISAR, interface electronics, and data collection software.

Note: details on the ISAR instrument are provided in the ISAR User Manual that was provided with the instrument. The manual is available on line at http://www.rmrco.com/proj/isar6daq4/isarmanual.pdf.

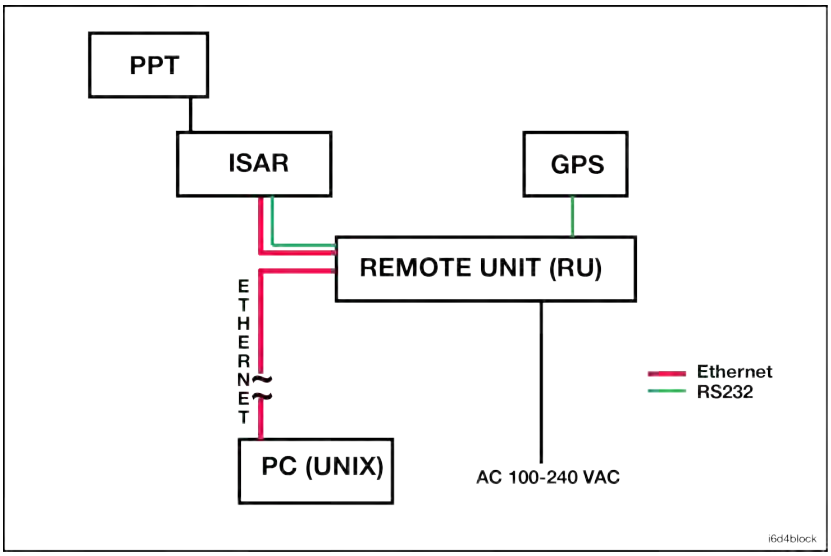

Figure 1: The system block diagram.

- **ISAR.** The instrument that looks at the sea surface and measures the $\mathtt{SST}_{skin}$ from the emitted infrared radiation.
- **PPT.** A sensitive percipitation sensor that is used by ISAR to close its shutter in case of rain.
- **GPS.** A GPS sensor to record exact position as part of the data record. The ISAR also has a GPS position.
- **REMOTE UNIT (RU).** The electronic interface to the ISAR. The RU provides power control, ethernet connectivity, and serial connectivity to the different components.
- **PC.** A laptop running BASH Unix. Software in the PC collect and log raw data from the different devices. Ten-minute statistics on $\mathtt{SST}_{skin}$, position, rain, and ISAR status.
- **AC Power.** The system runs on external AC power, 100-240 VAC & 50–60 Hz. Current drain is < 2 amps.

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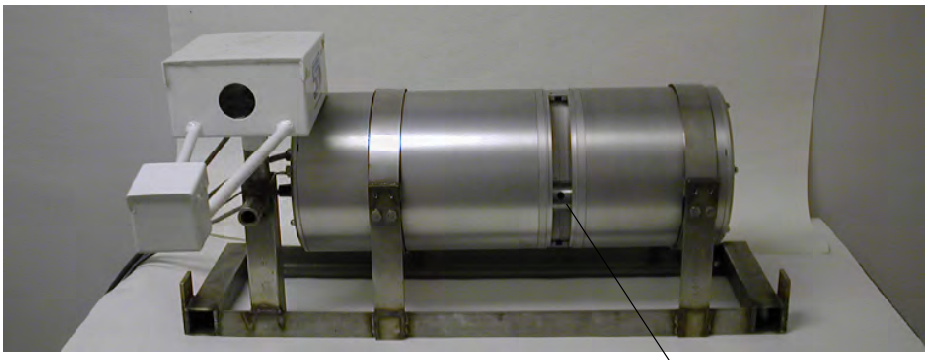
1.1 General Description of ISAR

This section is one-page description of ISAR. See the ISAR manual for information on service and operation.

Infrared Sea Surface Skin Temperature Radiometer (ISAR)



The Infrared Sea Surface Skin Temperature Radiometer (ISAR) is designed to provide sea-surface skin temperature (SSST) measurements in support of satellite calibration and validation activities. ISAR will be deployed on volunteer ships in a global network and its operational goals are to make observations autonomously from a ship at sea for six-months and with an accuracy of +/-0.1 C.

The tiny hole in the inner scan drum looks into a 45 degree mirror that reflects incoming infrared radiation into the infrared thermometer inside a waterproof housing, through a transparent window. The scan drum can be pointed to the sea surface at a variety of angles, at the sky, and back into two high-precision black-body cavities. This cycle allows correction for sky contamination and the system is self calibrating. A small amount of contamination can be tolerated by this open air design.

ISAR incorporates a pitch-roll sensor, a flux-gate compass, and a GPS and thus is completely self-contained. A measurement cycle can be completed as often as once per minute. The optical rain gauge (shown on the upper left side of the instrument) is an extremely sensitive detector of precipitation, and when any droplets in the air are encountered, the scan drum immediately rotates inward and the outer door closes.

The outer panel is retracted and the scan drum is rotated for viewing the sea surface or sky.

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1.2 Rain Sensor (PPT)

RAIN SENSOR Model 5.4103.20.041

Added to it are 12-24 V converter and 1200 ohm resistor for the 4-20 mA output.

Heaters are not used. Future models might add temperature control.

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1.3 The Data Acquisition System (DAQ)

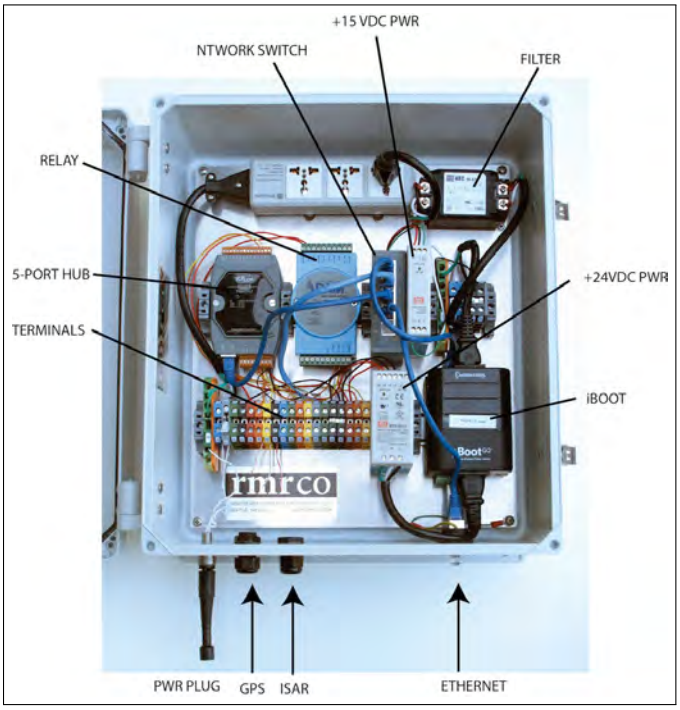

Figure 2: The DAQ4 Remote Unit (RU). The RU enclosure uses AC power and an Ethernet connection to the DAQ PC. Features include AC line filter, AC power control via the iBoot module, +15 & +24 volt DC power modules, DC power control to ISAR via the Relay module, and a five-port Serial-to-Ethernet hub (ISAR, Relay, GPS, Spare tilt, open).

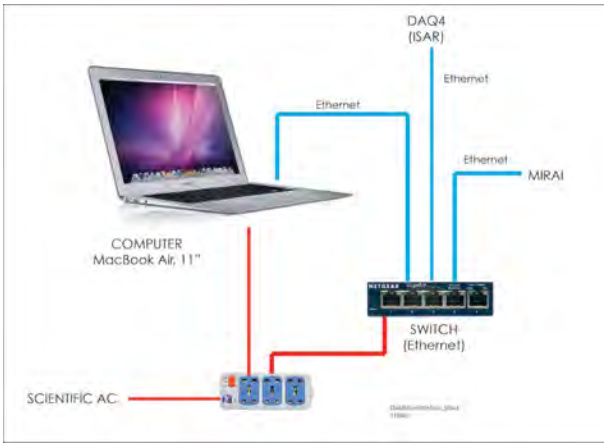

Figure 3: The DAQ4 User Interface (UI). The UI for this installation is simply a Mac Air 11" PC. Data collection software is written in Unix BASH shell, PERL, EXPECT, and Kermit.

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2 Installation

Figure 4: The DAQ4 installation on the top of the foremast on MIRAI. The rain sensor is at the upper left and the GPS at the upper right. The power and Ethernet connections are available.

2.1 Installation Guidelines

- **View to the sea surface.** The ISAR must be able to view the *undisturbed* sea surface at an angle, from downward, of approximately 15–55°. The view must be ahead of the ship wake. The most common view is directly to port or starboard.
- **AC Power.** A stable AC power source (100-240 VAC, 50-60 Hz, > 2A). Research vessels usually provide a UPS stable power for science and this should be used.
- **Ethernet.** An Ethernet connection to the UI PC is either a direct connection or via router into the ship LAN. Note: Before beginning the installation a set of IP addresses are required. This can be either assigned by the R/V network (best) or as a direct closed LAN. Table 1 is the set up for the MIRAI.

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Table 1: A table of IP addresses for R/V MIRAI.

DEVICE	IP	PORT	DESCRIPTION
PC	128.20.8.10		Central DAQ computer.
ISAR	128.20.8.11		Ethernet connection to the ISAR.
Hub	128.20.8.12		Five port Serial-to-Ethernet Hub.
ISAR	"	10001	Serial connection to ISAR. 9600 bps, 8n1.
Relay	"	10002	RS485 connection to the Adam 4017 DC relay.
GPS	"	10003	Serial connection to the GPS. 9600 bps, 8n1.
Tilt	"	10004	Serial connection to backup tilt sensor.
Spare	"	10005	Unused port. Setaside for future telemetry.
iBoot	128.20.8.13		AC power switch.
Cal Hub	128.20.8.14		Three-port Hub for the calibration system.
Mask	255.255.0.0		LAN mask.
DNS	128.20.1.240		Domain name server address.
Gateway	128.20.1.240		Gateway address.

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3 Data Collection Quick Start

1. **Check all connections.** ISAR is in its frame. Rain sensor is connected. DAQ power and ethernet are connected.Check all connections are in place.
2. **AC on.** Turn on AC power to the DAQ. Turn on the iBoot. (Ref 7.1.)
3. **Ping the hub.** Use the PingHub command to confirm the DAQ hub is active. (Ref 8.1.)
4. **Ping Isar.** Use the PingIsar command to confirm the Isar is active.
5. If the pings are NOT good then
   ◇ Double-check all connections.
   ◇ Cycle the power with the iBoot command and the web page controls.(Ref 7.1.)
6. **Check ISAR Serial.** Enter the I command and be sure isar data lines are coming in correctly. (Ref 8.2.)
7. **Check GPS.** Enter the P command and check the GPS data records are coming properly. (Ref 8.3.)
8. **Edit setup file, su06.** Double check and edit the setup file. (Ref 5.1.)
   ◇ `edsu` to edit key lines.
   ◇ `EDsu` to edit the complete setup file using BBEdit.
   Note: Edit the setup file only as necessary.
9. **Create the data set folder.** Finally: if all checks out enter the `START` command to create the data set folder. (Ref 9.)
10. **Begin data collection.** Enter the `G` command to begin data collection. (Ref 9.3.)

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4 Preparation to Begin Operation

4.1 Turn ON the PC

The laptop for the DAQ4 is an Apple Mac Air, 11". The computer software is written Unix with a BASH shell. The software work well in a Linux (Ubuntu) operating system using a BASH shell.

Turn on the power switch. The computer boots the programs and ends as the screen below.

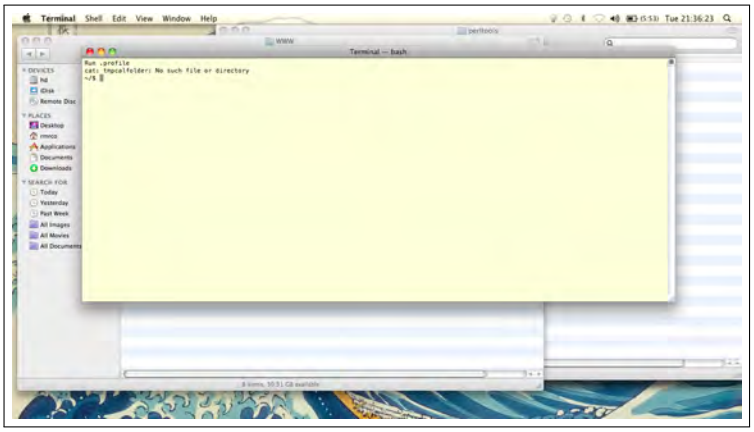

Figure 5: The Unix terminal screen (light yellow background here) should be at the home folder.

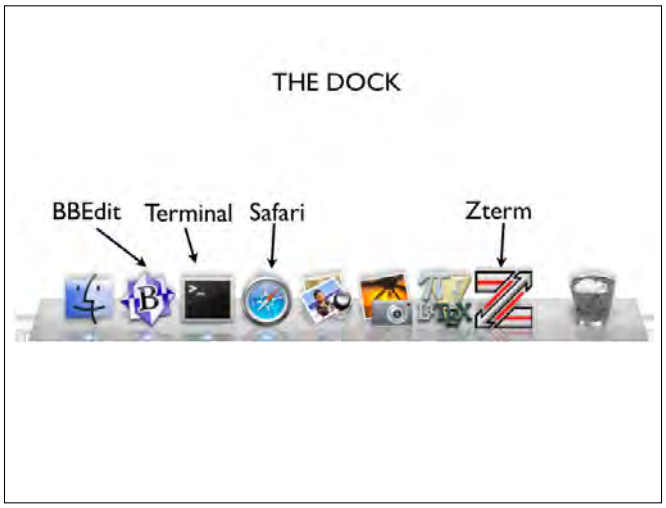

Figure 6: The DAQ Mac OS X Dock.

The most important programs for general use are (from left to right):

◇ BBEdit: An excellent text editor with many features.

◇ Terminal: Opens a new UNix terminal window.

◇ Safari: Internet browser.

◇ Zterm: A serial terminal for RS232 connections.

4.2 Sleepless Power Control

Normally the computer goes to sleep when the lid is closed or after a set time. Sleepless is a program that disables the sleep action.

The upper right menu will look approximately like this:

Figure 7: The upper-right side of the task bar.

- Move the mouse pointer to the lightbulb on the left end of the menu above.

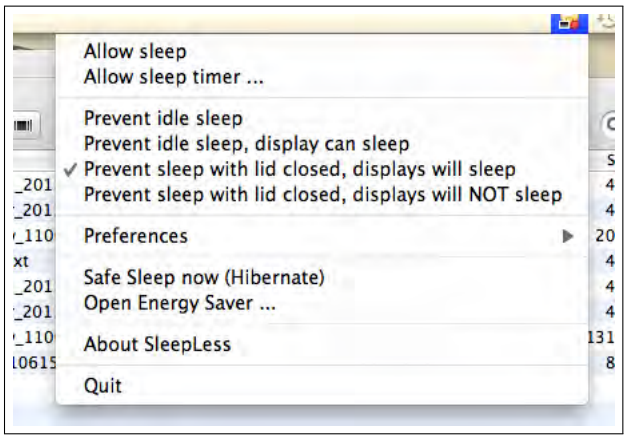
Allow sleep
Allow sleep timer ...
Prevent idle sleep
Prevent idle sleep, display can sleep
Prevent sleep with lid closed, displays will sleep
Prevent sleep with lid closed, displays will NOT sleep
Preferences
Safe Sleep now (Hibernate)
Open Energy Saver ...
About SleepLess
Quit

Figure 8: The Sleepless Menu. The sleepless icon in the menu bar as shown above has a red tag when it is set properly.

- In the menu select "Prevent sleep with lid closed, displays will sleep" as shown.

4.3 Set the Ethernet addresses.

Refer to table 1 or one like it for the installation. Each of the devices must be set to the correct IP, mask, and router if needed. The DAQ PC must be set to the PC address.

- Open `Apple->System Preferences->Network`.
- Set up a Location for the installation. (Check to be sure a proper Location has not been already set up.) The IP assignment should be manual.
- Set the IP address, Mask, and Router if that has not been assigned.

4.4 Go to the DAQ Folder

Open a terminal window and enlarge it, by dragging the corner, to almost full screen size.

Jump to the DAQ software folder by entering the alias **gtisar**.

```
~/$ gtisar
~/ISAR/isardaq/$
```

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5 DAQ Setup File — su06.txt

The DAQ setup file full name is `$HOME/ISAR/isardaq/setup/su06.txt`
It contains information for data collection and computation of SSST.

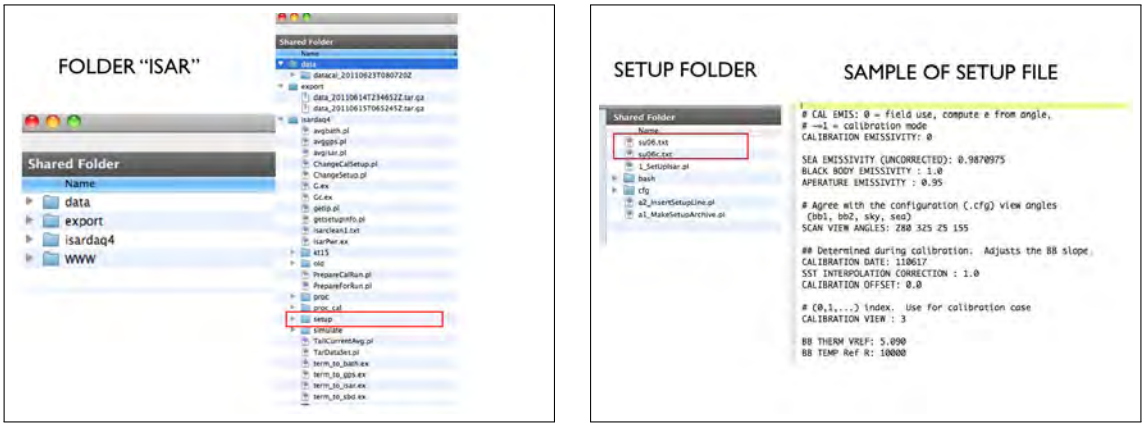

Figure 9: Setup file.

The setup file controls almost all of the DAQ real-time operation and real-time data processing. View the file with the Unix "less" program

```
~/ISAR/isardaq/$ less /setup/su06.txt
```

A typical setup file can be found in the Appendix. A setup record line has a "tag" followed by a colon (:) followed by the datum for that line. Thus a line such as

```
SST INTERPOLATION CORRECTION: 1.0033
```

has a tag, "SST INTERPOLATION CORRECTION," and the datum (1.0033). Exact line numbers are not important. The software searches for the tag string.

Note: Software searches for the tag string only. Therefore there is no penalty for adding comment lines in the file to help describe the data. The setup file shown in appendix C has many comment lines and insertions.

5.1 Edit the DAQ Setup file

5.1.1 On BBEdit

BBEdit is a powerful text editing program. Most of the working files in the DAQ4 system are text (ASCII) files and can be edited easily using BBEdit. To begin the editor simply double-click on

any menu item with the BBEdit icon. Any files of type text (.txt), hypertext (.html), perl (.pl), or Expect (.ex) will open with the BBEdit text editor.

There are many text editors in the Unix system. “nano”, “vi”, and others can be used for simple edits. However, we recommend highly that the operator here become familiar with BBEdit.

A complete manual, “BBEdit_10_User_Manual.pdf,” is provided for for reference. However, the easiest way to learn the editor is just to use it.

5.1.2 edsu — Quick edit

Runs a program to make changes to the most important lines in the setup file.

5.1.3 Edsu — Full Edit

Brings up BBEdit for a full edit of the setup file.

5.1.4 BUsu — Backup Setup File

Makes a backup

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6 Working with the ISAR

6.1 SSH to ISAR

1. Open a DAQ terminal window.

2. SSH to ISAR.
   (a) From DAQ terminal command line prompt, "../$", enter
   `sshisar`
   or
   `ssh root@128.20.8.11`
   (b) password = "`arcom`"
   (c) `cd /home/isar/software`

6.1.1 To Monitor ISAR Raw Data with SSH

- Go to the data folder: `cd \home\isar\software\data`
- Read the last line of the data file: `\tail -f fname`
- To exit tail: `<control>-C`
- To exit SSH: `exit`

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6.2 Kill the ISAR Program

1. Enter `ps -ax`
2. Select the first pid (figure 10 left panel).
3. kill the program (right panel)

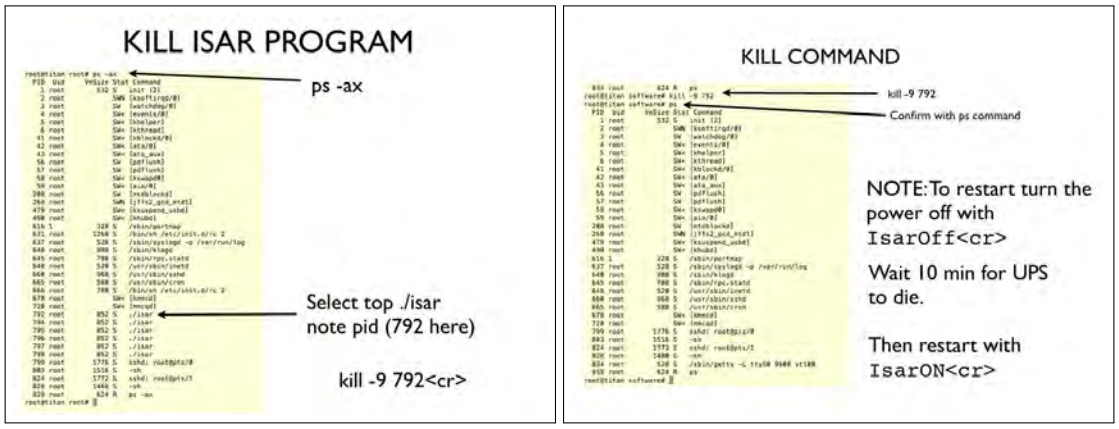

Figure 10: Kill the ISAR program.

6.3 Exchange Files using Fetch

Use the fetch command to the config file from the PC to ISAR.

Start fetch to ISAR: `fetch isar@128.20.8.11`

Password: `arcom`

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6.4 ISAR Tools Test Program

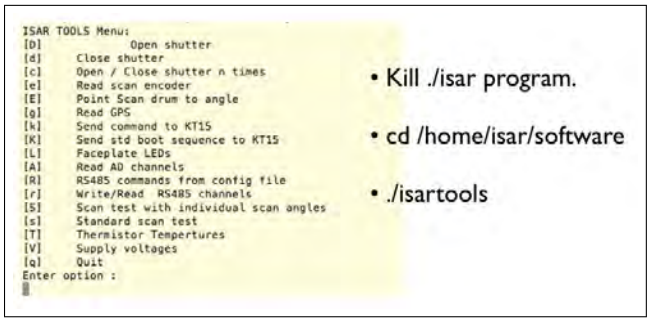

ISAR TOOLS Menu:
[D] Open shutter
[d] Close shutter
[c] Open / Close shutter n times
[e] Read scan encoder
[E] Point Scan drum to angle
[g] Read GPS
[k] Send command to KT15
[K] Send std boot sequence to KT15
[L] Faceplate LEDs
[A] Read AD channels
[R] RS485 commands from config file
[r] Write/Read RS485 channels
[S] Scan test with individual scan angles
[s] Standard scan test
[T] Thermistor Tempertures
[V] Supply voltages
[q] Quit
Enter option :
• Kill ./isar program.
• cd /home/isar/software
• ./isartools

Figure 11: ISAR Tools menu.

6.5 ISAR Configuration File — isarconf.cfg

The ISAR configuration file is located in the software folder in the ISAR computer.

```
/home/isar/software/isarconf.cfg
```

This file contains information on the ISAR and ISAR operation. When the program boots up it reads the config file.

Data lines in the configuration file are constructed like the lines in the DAQ setup file except an equal sign (‘=’) is used instead of the colon as a separator. E.g.

```
START_DIAGN=0
```

is a typical line in the ISAR config file.

A copy of the configuration file is located on the DAQ PC as
`$HOME/ISAR/isardaq/setup/cfg/isarconf_run.txt`

6.5.1 Procedure to Change the Configuration file.

1. Copy `isarconf.cfg` to the DAQ PC. Do this if you are unsure if you have the current config file in the DAQ PC.

   Use fetch (section 6.3) to copy `isarconf.cfg` from ISAR to the PC. The name of the file on the PC is `isarconf_run.txt`.

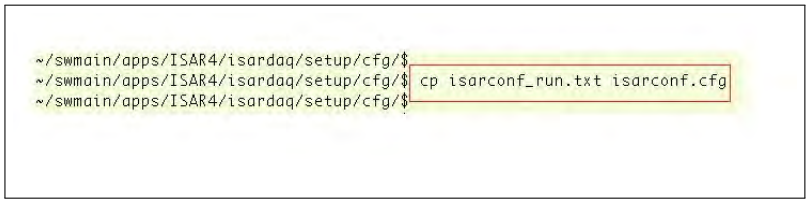
2. Edit isarconf on the DAQ PC. Use BBEdit or other editor.

   Use BBEdit to edit `isarconf_run.txt` on the PC.

3. Copy `isarconf_run.cfg` to ISAR.

4. Replace `isarconf.cfg` with the new version.

   `cp isarconf_run.txt isarcong.cfg`



5. Alternate: Edit `isarconf.cfg` directly in ISAR.

   Edit the `isarconf.cfg` file directly in the ISAR. Make use of the text editor “vi” in Unix. Any other available (in the ISAR OS) text editor (e.g. nano) will do.

   As an example in this procedure we will edit the line tagged “`ORG_MEAN_LIMIT=1.1`” which sets the threshold for the rain sensor to actuate the shutter.

   This is an archive file. We will edit this then copy it to `isarconf.cfg`.

   (a) `vi isarconf_run.txt`

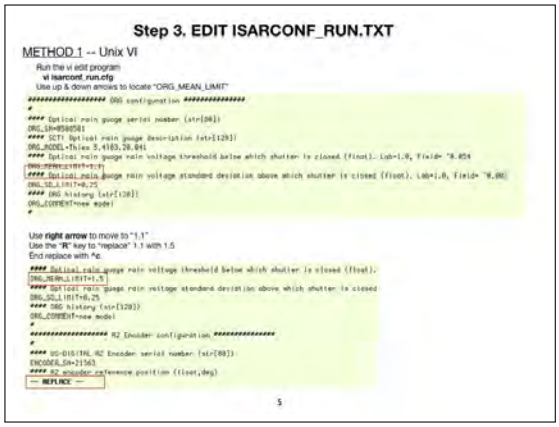
   (b) Find the line `ORG_MEAN_LIMIT=1.1`

   (c) Change to `ORG_MEAN_LIMIT=1.5`

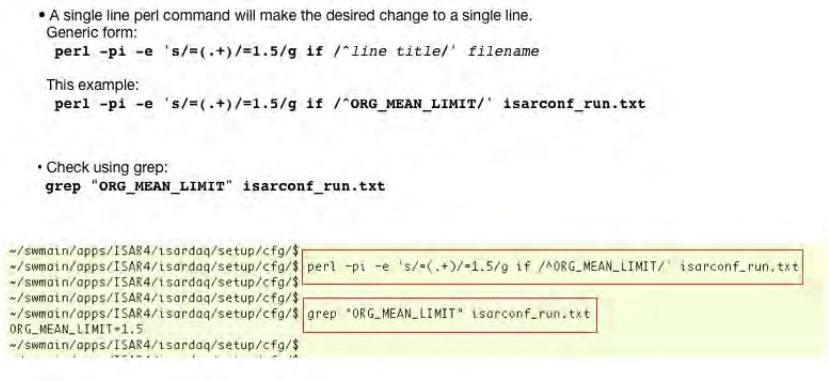
   (d) Move the cursor to `1.1`

   (e) ’R’ and enter `1.5<esc>`

   (f) Save and exit: `:wq<return>`


Step 3. EDIT ISARCONF_RUN.TXT
METHOD 1 -- Unix VI
Run the vi edit program
vi isarconf_run.cfg
Use up & down arrows to locate "ORG_MEAN_LIMIT"
Use right arrow to move to "1.1"
Use the "R" key to "replace" 1.1 with 1.5
End replace with ^e.
-- REPLACE --
5

Alternate method of direct edit. A single command can be used to change a single line in the configuration file.


• A single line perl command will make the desired change to a single line.
Generic form:
perl -pi -e 's/=(.+)/=1.5/g if /^line title/' filename
This example:
perl -pi -e 's/=(.+)/=1.5/g if /^ORG_MEAN_LIMIT/' isarconf_run.txt
• Check using grep:
grep "ORG_MEAN_LIMIT" isarconf_run.txt
~/swmain/apps/ISAR4/isardaq/setup/cfg/$
~/swmain/apps/ISAR4/isardaq/setup/cfg/$ perl -pi -e 's/=(.+)/=1.5/g if /^ORG_MEAN_LIMIT/' isarconf_run.txt
~/swmain/apps/ISAR4/isardaq/setup/cfg/$
~/swmain/apps/ISAR4/isardaq/setup/cfg/$
~/swmain/apps/ISAR4/isardaq/setup/cfg/$ grep "ORG_MEAN_LIMIT" isarconf_run.txt
ORG_MEAN_LIMIT=1.5
~/swmain/apps/ISAR4/isardaq/setup/cfg/$

6.6 Reboot ISAR Operation

1. Quit the SSH connection and return to the DAQ terminal.
   Enter `exit`.
2. Quit data collection if necessary. At the DAQ window, enter `^c`.
3. From the command line ($) enter `IsarOff`. See figure 8.1.
4. Wait 10 minutes for battery backup to discharge.
5. Enter `IsarOn`

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7 Power Control

7.1 iBoot AC Power Control

To view this page, you must log in to area "iBoot-G2" on 128.20.8.13:80.
Your password will be sent unencrypted.
Name:
Password:
Remember this password in my keychain
Cancel
Log In

Figure 12: iBoot Log On window

- Enter the command `iBoot`

or

- Enter the command `Safari http://128.20.8.12`

or

- From Safari, enter URL `http://128.20.8.12`.

Name: user
Password: daq4

After entering the Name and Password the main iBoot menu will appear.

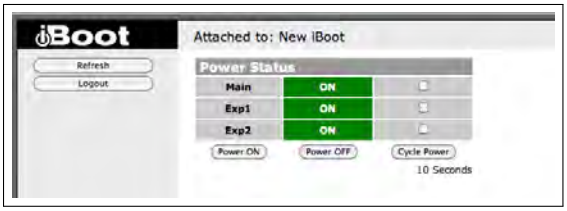

Figure 13: iBoot power control window.

- Check the Main checkbox.
- Press the power control button to turn power ON or OFF.

NOTE: The ISAR has an internal power backup so the “Cycle Power” function is not useful to reboot ISAR. Instead, to reboot ISAR,

- Press the “Power On” button.
- Wait three minutes.
- Press the “Power On” button.

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7.2 ISAR DC Power Control

The ISAR DC power passes through a DC relay (Adma 4017) so the operator can cycle power to the ISAR alone without effecting other devices.

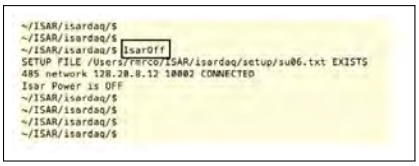

Figure 14: Recycle DC power to ISAR.

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8 Ping and Confirm Operation

Before beginning data collection a series of tests are used to assur that all of the different modules are connected and operational.

8.1 Ping commands

We “ping” each component to be sure the ethernet links are all working.

```
>>20110806T171625Z, 875,1,0,  1.8,-5.1, 155,  599,2812,2812,2813,2121,
~/ISAR/isardaq/$ ping 139.166.246.43
PING 139.166.246.43 (139.166.246.43): 56 data bytes
64 bytes from 139.166.246.43: icmp_seq=0 ttl=64 time=8.098 ms
64 bytes from 139.166.246.43: icmp_seq=1 ttl=64 time=0.528 ms
64 bytes from 139.166.246.43: icmp_seq=2 ttl=64 time=0.540 ms
64 bytes from 139.166.246.43: icmp_seq=3 ttl=64 time=0.658 ms
64 bytes from 139.166.246.43: icmp_seq=4 ttl=64 time=0.657 ms
64 bytes from 139.166.246.43: icmp_seq=5 ttl=64 time=0.568 ms
64 bytes from 139.166.246.43: icmp_seq=6 ttl=64 time=0.641 ms
64 bytes from 139.166.246.43: icmp_seq=7 ttl=64 time=0.522 ms
64 bytes from 139.166.246.43: icmp_seq=8 ttl=64 time=0.605 ms
64 bytes from 139.166.246.43: icmp_seq=9 ttl=64 time=0.658 ms
^C
```

Figure 15: Pinging a module on the network.

The ping command can be entered in a command window simply as (in the case of the hub)

`ping 128.20.8.12`

where the IP address is the one assigned and shown in table 1.

PingHub	Pings the hub module.
PingiBoot	Pinfs the iBoot AC power module.
PingCal	During a calibration setup pings the Hart Readout module.
PingIsar	Pings the ISAR instrument ethernet connection.
PingMe	Pings the DAQ PC.

8.2 I — Direct Connect to ISAR

The “I” command runs a kermit program to make a direct connection to the ISAR via its RS232 serial connection. The raw output from the ISAR will be displayed.

This connection can be used to terminate the ISAR operation by entering “T”.

Terminate an I session by entering ‘`<control>-\`’ followed by ‘`Q`’.

8.3 P — Direct Connect to GPS

Enter “P” to connect to the GPS. The output should be a GPRMC string every ten seconds.

Terminate a P session by entering ‘`<control>-\`’ followed by ‘`Q`’.

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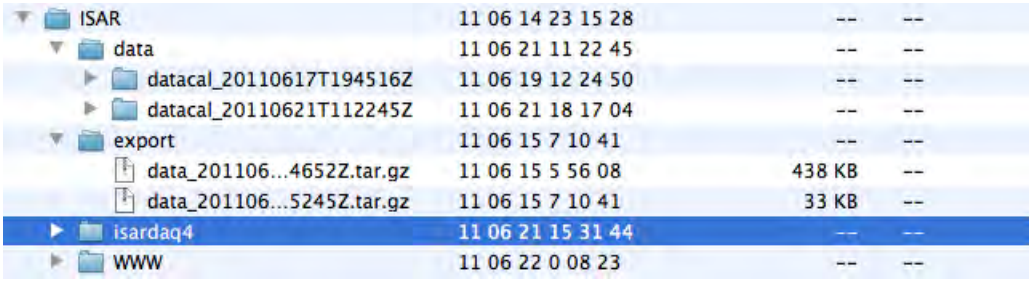
9 START Operation

9.1 DAQ ISAR File Structure

The "ISAR" folder has the following structure.



The top four folders are

data: contains all data sets. A "data set" is all the data files and setup files for a particular data collection run.

export: is a repository for compressed archive folders. Data sets are moved here before distribution or archive.

isardaq: contains all software for the DAQ4.

refs: Contains this manual, the ISAR manual, and other useful data.

www: are the html and other files that make up the DAQ4 description.

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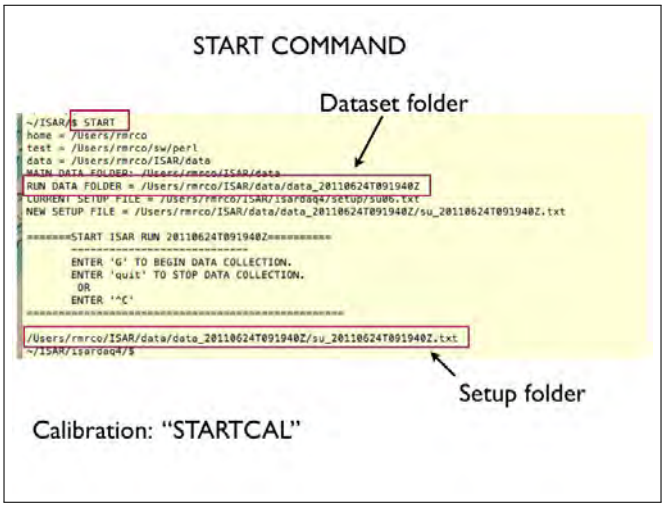
9.2 The START Command

Definition of a "Data Set". A data set is a block of observations with the same setup files and with the a common scientific purpose. A data set is defined by time. A data set is initialized by the "START" command. When the START command is entered the following folder is created

```
ISAR/data/data_20110617T194516Z
```

When the STARTCAL command is entered a calibration data set is created

```
ISAR/data/datacal_20110617T194516Z
```



The START command.

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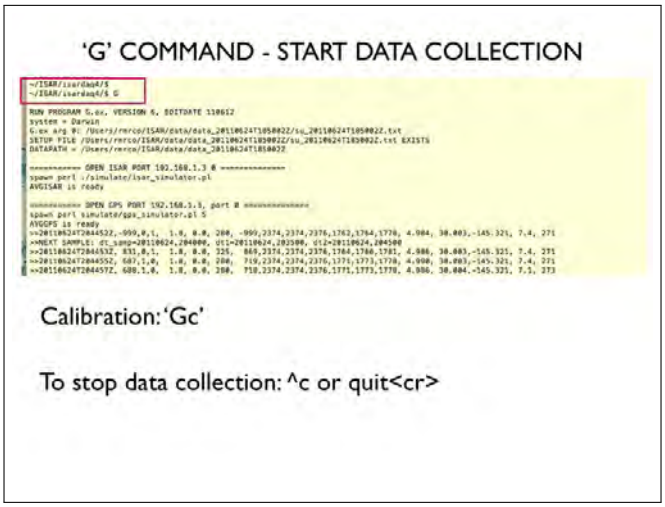
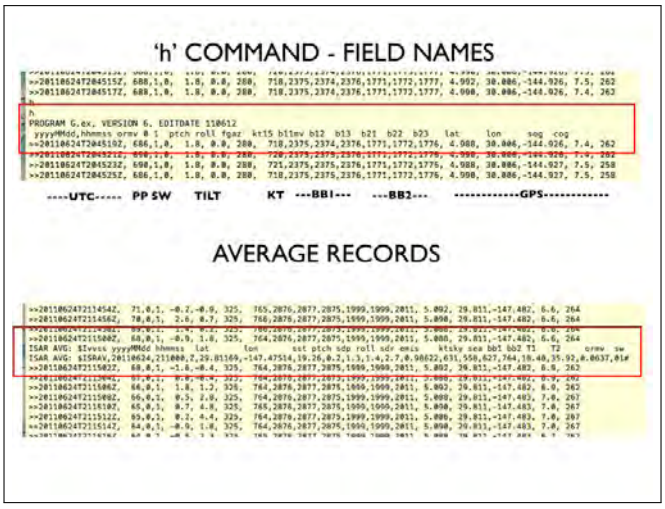
9.3 G, Begin data collection.



G Command.



Data Collection Screen.

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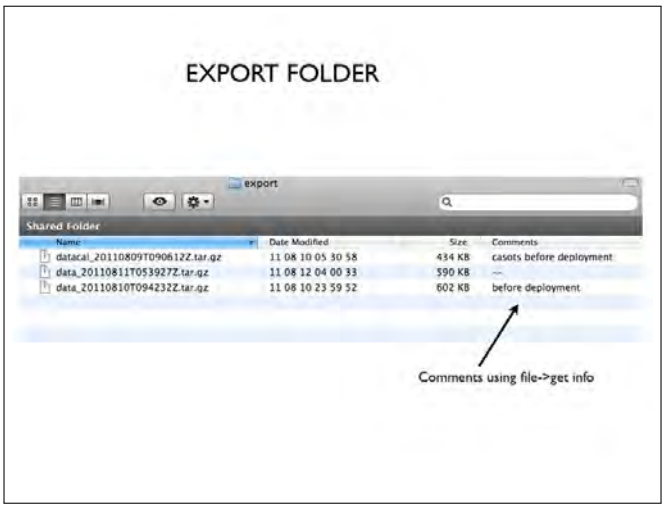
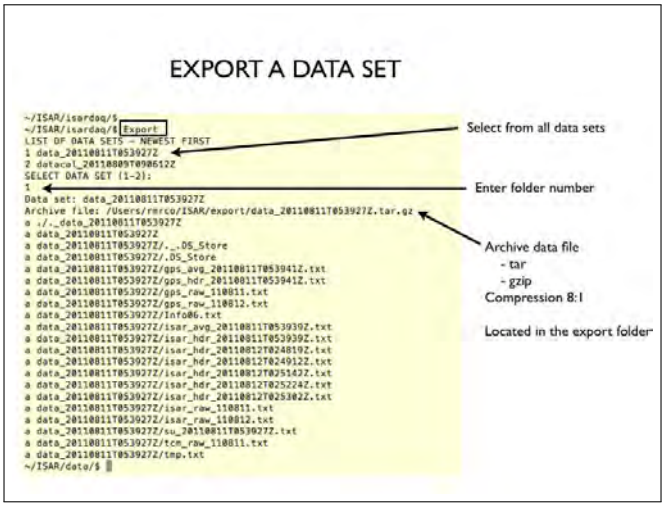
10 Stop data collection & Data Export

10.1 Terminate Data Collection

10.2 Export an Archive File



The Export folder.



The export command.

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11 Calibration

11.1 Calibration System Description

CASOTS 4000l/hr (67l/min = 16 gpm) with 24 VAC 50 Hz. 50 Hz is important. A transformer to convert 100 VAC to 24 VAC

Probe Thermometrics #225 Hart #1504

Tweener Readout 1504 Tweener Thermistor Readout If you need more accuracy in a limited temperature range, the Model 1504 Tweener gives it to you as a thermistor readout. Thermistors are less fragile than PRTs and less likely to be impacted by mechanical shock. Thermistors are more sensitive to temperature, have faster response times, and come in many shapes for different applications.

Typical accuracy of a 1504 is ś0.002 C with a resolution of 0.0001 C.

Model	5642
Diameter x Length	3.18 x 229 mm (0.125 x 9 in)
Range	0–60 C
Drift	ś 0.002 C/Year
Accuracy (Mfr.)	
Wires	
Nominal Resistance at 25 C	

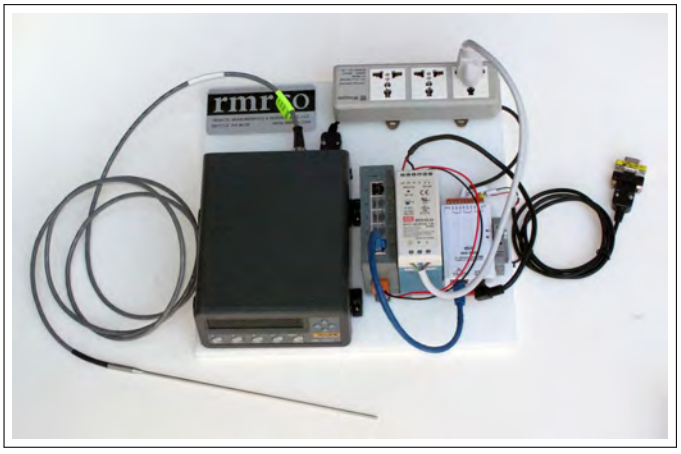

Figure 16: Calibration electronics.

Prepare for the Calibration.

1. Remove ISAR from the foremast. Leave all cables. Wrap unconnected cables in a plastic bag to protect from weather.
2. Service ISAR as needed. See service procedure.
3. Place the ISAR in front of the CASOTS bath.

4. Connect the ISAR test cable. Make sure all connections to the cal system are correct.
5. Turn on AC power to the calibration system. Check the lights on the switch, hub to be sure power is on to all devices.
6. Connect the Mac Air (or a calibration PC if different) ethernet connection to the network switch on the calibration circuit.
7. Ping the calibration hub with the `PingCalHub` command. The ping must be successful.
8. Connect to the ISAR with the `Ic` command. The ISAR data lines should be correct. Note: For the calibration the ISAR view angles are 325, 280, 25, and 90 degrees.
9. Turn on the Hart temperature readout. Check that the probe is inserted into the bath properly. Check that the temperature readout is degC.
10. Check the temperature probe with the `B` terminal command. The readout should produce temperature records each 2 seconds.

    Begin the Calibration.

11. Add ice to the bath water to cool the bath to at least 10 degC.
12. Use the `B` terminal command and check the start temperature is low enough. End the connection with `<control>-\` followed by `Q`;
13. If everything checks out enter `STARTCAL` to setup the calibration data folder (`datacal...`).
14. Begin data collection with the terminal command Gc.

    Ending the Calibration.

15. End the calibration when the water temperature exceeds 35 degC. Enter `<control>-C` to terminate the data collection.

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A PARTS

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Indented Part List

Full Parts Spreadsheet

Test Full Parts Spreadsheet

ISAR6-DAQ4 INDENTED PART LIST		2011 08 15							
pn	**ECCN**	**1**	**2**	**3**	**4**	**5**	**6**		**DESCRIPTION**
		ISAR-DAQ COMPLETE SYSTEM							Complete Isar6 and DAQ4 system delivered to JAMSTEC
			ISAR6 SYSTEM						
1				ISAR					Isar instrument provided by SOES
1.1					BLACK BODY ASSEMBLY				
1.1.1						THERMISTORS			3 thermistors, YSI46xxx, in each BB
1.1.2						HEATER			
1.1.3						BLACK CONE			
1.1.4						PLASTIC SLEEVE			
1.1.5						CONNECTOR			
1.2					SHUTTER ASSEMBLY				
1.2.1						SHUTTER MOTOR			
1.2.2						SHUTTER GEAR			
1.2.3						DRIVE BELT			
1.2.4						SHUTTER SWITCH ASSEMBLY			
1.2.4.1							SWITCH BLOCK		
1.2.4.1							SWITCH, HALL EFFECT		
1.2.4.2							MAGNETS		
1.3					SCAN DRUM ASSEMBLY				
1.3.1						SCAN DRUM MOTOR			
1.3.2						ENCODER, SCAN DRUM			
1.3.3						ENCODER			
1.3.4						CONNECTION CABLE			
1.3.5						MIRROR			Gold mirror
1.4					INFRARED RADIOMETER				
1.5					ELECTRONICS PACKAGE				
1.5.1						COMPUTER STACK, PC104			
1.5.2						CONNECTION BOARD			
1.5.3						POWER CONTROL BOARD			
1.5.4						ANALOG, THERMISTOR BOARD			
1.6					SYSTEM THERMISTOR SET				
1.7					TILT-FLUXGATE COMPASS				
1.8					GPS				
1.9					PRECIP SENSOR				Thies Clima (modified by SOES)
1.10					CABLE I1				Lemo pigtail, length=3m, main plug, GPS, Ethernet, RS232.
1.11					CABLE I2				Lemo pigtail, length=3m, rain sensor plug
1.12					UPS BOARD				Uninteruptable circuit
1.13					ANTENNA, GPS				
1.14					WINDOW, IR				
4			**DAQ4 DATA INTERFACE**						Complete data and control interface manufactured by RMR co.
4.1				**RU - REMOTE UNIT**					Weatherproof enclosure mounted with isar
4.1.1					GPS				Garman GPS17X, NMEA GPRMC, 10 sec rate
4.1.2					GPS cable				Provided with the GPS. Modified for 3-wire rs232.
4.1.3					POLE GPS MOUNTING				Schedule 40 PVC nipple
4.1.4					ENCLOSURE				Polycarbonate, 440x389x170 mm, twist latches, non-metallic hinges
4.1.5					MOUNTING PLATE				VJ 1614 ALUMINUM MOUNTING PLATE (MP1614A)
4.1.6					BOLT, PLATE FASTENER (4)				316 SS
4.1.7					WASHER, FLAT (4)				316 SS
4.1.8					WASHER, LOK, SPLIT				316 SS
4.1.9					DIN RAILS (3 EA)				316 SS DIN rails, 300 mm, 300 mm, 160 mm long
4.1.21					POWER STRIP				Three outlet power strip, International plug style
4.1.23					FILTER, LINE				AC line filter, 250 VAC, 50/60 Hz
4.1.24					HUB, ETHERNET				Serial to Ethernet, four RS232 and one RS485.
4.1.25					DC RELAY				RS485 relay module, RS485 controlled.
4.1.26					SWITCH, NETWORK				Five port Ethernet switch
4.1.27					POWER SUPPLY, 15 VDC				DC power module, 15 V, 0.67 A output
4.1.28					POWER SUPPLY, 24 VDC				DC power module, 24 V, 2.5A output
4.1.29					AC POWER SWITCH				Web enabled switch, one port
4.1.40					TERMINAL DIN BLACK (6)				Din rail contact module
4.1.41					TERMINAL DIN RED (2)				Din rail contact module

4.1.42	TERMINAL DIN ORANGE (3)	Din rail contact module
4.1.43	TERMINAL DIN GREEN (3)	Din rail contact module
4.1.44	TERMINAL DIN YELLOW (3)	Din rail contact module
4.1.45	TERMINAL DIN BLUE (4)	Din rail contact module
4.1.46	TERMINAL, DIN, GROUND (2)	Din rail contact module
4.1.47	END CLAMPS, DIN (7)	Din clamp, screw down.
4.1.48	DISCONNECT, DIN TERMINAL	
4.1.49	DISCONNECT END SECTION	
4.1.50	JUMPERS, TERMINAL	Short DIN terminals together.
4.1.60	SCREW, DIN FASTENER (10)	316SS, M4
4.1.61	WASHER FLAT (10)	316SS, M4
4.1.62	WASHER, SPLIT LOK (10)	316SS, M4
4.1.63	NUT, DIN FASTENER (20)	316SS, M4
4.1.64	MOUNTING CLIP, DIN	Din rail mounting clip for terminal strip
4.1.70	RECEPTACLE, ETHERNET	Waterproof RJ45 receptacle
4.1.71	RECEPTACLE POWER	Underwater Impulse MCBH-3MP (male pins)
4.1.72	CABLE FEED-THROUGH (2 EA)	Heyco® Liquid Tight Cordgrips Straight-Thru, PG Hubs,
4.1.73	CABLE, AC POWER, PIGTAIL	Molded MCIL-3FS Impulse, 1 m short pigtail to spplice onto ships cable.
4.1.75	CABLE, ETHERNET, EXTERNAL	Weatherproof mate for RJ45 receptacle.
4.1.80	IRIDIUM MODEM (option)	
4.2	**UI - USER INTERFACE**	Computer and network interface components operates the RU.
4.2.1	COMPUTER, LAPTOP	Mac Air laptop, OS X, Unix
4.3	**CI - CAL INTERFACE**	Temperature probe, network components,. Mates with the CASOTS bath.
4.3.1	BATH, CASOT	Water bath (from SOES)
4.3.2	CABLE I2	Lemo pigtail, length=3m, same as 1.1.3 but no GPS.
4.3.10	READOUT TEMPERATURE	Hart digital readout
4.3.12	PROBE, THERMISTOR	Hart precision probe
4.3.14	CABLE, SERIAL READOUT	RS232 cable, DB9 to pig tail for HUB
4.3.16	HUB, SERIAL-TO-ETHERNET	
4.3.18	CABLE, CAT5, HUB	Ethernet cable connect hub to switch
4.3.20	CABLE, CAT5, COMPUTER	Ethernet cable connect switch to PC or Ship network
4.3.22	SWITCH, ETHERNET	
4.3.28	POWER SUPPLY, 24V	Power for the isar
4.3.30	DIN RAIL	
4.4	**MOUNTING FRAME**	Mounting hardware and components for calibration

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B User Interface PC — Setup

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This document provides a general overview of the complete installation of the Infrared Seasurface Temperature Autonomous Radiometer (ISAR) instrument and data acquisition hardware and software for the R/V MIRAI.

B.1 Technician Requirements

The DAQ4 PC is basically a Unix application. The operators need to be familiar with the following:

- Unix/Linux and specifically the BASH shell.
- Mac OS X
- Basic networking principals using Unix/Linux.
- Become familiar with the text editor program `BBEdit`.

B.2 File structure.

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The UI PC file structure should be as follows:

```
home
   /data                                  Data folders.
      /data_20110812T041450Z                  Typical data folder name.
   /export                                Tar-zip archive of data folders.
     /data_20110810T094232Z.tar.gz            Typical name of a compressed data folder.
   /isardaq                               All software and setup files
     /kt15                                    Heitronics bandpass data.
     /proc                                    Post-deployment processing code.
     /proc_cal                                Post-calibration processing code.
     /setup                                   DAQ setup files (su06 and su06c)
         /cfg                                     \isar\ operation configuration files.
         /bash                                    Unix .bashrc files.
     /simulate                                Simulation software and simulate data files.
   /tools                                 Processing software modules
       /perltools                             PERL code modules.
       /socket                                Code for TCP/IP socket.
   /www                                   Web page for quick reference
       /parts                                 Parts spreadsheets and information.
           /AllParts                              All information on parts listed in the part list.
               /1_ISAR                                ISAR parts, manuals, etc.
               /4_DAQ4                                DAQ4 parts, manuals, etc.
           daq4_spreadsheet.pdf                   Complete spreadsheet for the DAQ4 system.
```

```
    ISAR-DAQ4_IndentedParlList.pdf       Indented (quick look) spreadsheet.
/refs                                Reference documents, papers.
/slideshow                           Slideshow describing the DAQ4 system and operation.
/training                            Training slide show.
/UserDocs                            All user documentation used in the web pages.
```

B.3 Steps to Setup a New PC

User files install the latest user files. These can be obtained from RMR Co. It is suggested that these be provided directly from RMR Co. by email/ftp data transfer.

Xcode Tools The programmer's package "Xcode Tools" must be downloaded from the Apple Xcode Web site. It costs a small amount for the package (≈$10). The download file is very large (approx 800 MB) so allow plenty of time for the transfer.

Xcode installer After the Xcode Tools package is installed, and this could take a few hours, you must run the installer package. Go to the Applications folder and double-click the "Install Xcode" application.

Reboot At this time reboot the computer so the Xcode package is loaded into the operating system.

MacPorts The MacPorts package is a method for downloading and installing software packages, 'ports', automatically and easily. Go to the MacPorts download page and follow the instructions. A good user guide is available on line.

- Check the install is successful by entering "`port` and the reply should look like "`MacPorts 1.9.2`" followed by a prompt. Enter "`quit`" to end the port application.

Terminal Configure the Terminal (Unix shell) application.

- Run the Terminal window. In preferences, under the "Window" tab, set "Window Size" to Columns=155 and Rows=32. Number of rows set to 10000.
- Under the "Shell" tab, Startup:Run Command field is blank.
- All other settings such as color or keyboard settings can remain default.
- From a terminal window use the "nano" application to edit the file named "`~/.profile`" so the last line containes the command "`bash`".

Kermit Install the Kermit software. A good site for this is via the MacUpdate site.

- Download the Kermit package, `kermit80212`, and place it in the `~\sw\` folder.
- `cd` to the kermit folder and run "`make macosx`".
- Next run the command "`cp wermit /usr/bin/kermit`" to place the program in the correct location.
- Using 'nano' or other text editor create a file `~\.kermrc` in the home directory with the line "`prompt k>>`".
- Check the install by entering "`kermit`" in a terminal window. You should see a prompt, "`k>>`". Enter "`version`" and the reply should include a line with something like
  "`C-Kermit 8.0.212 Dev.26, 20 Dec 2006, for Mac OS X 10.5.7`".
- Quit kermit with the "`quit`" command.

TeXShop The TeXShop package is useful for upgrading documentation.

- TeXShop can be downloaded and installed from TexShop Home Page.

- Additional packages are needed. Create a folder in the Unix home directory ("`cd ~/`") called "`~/tex/`"
- Copy the RMR Co. folders `texstyles` and `texinput` into this folder. These are available from RMR Co..

R The statistics and plotting package called "`R`" is used in some presentation and processing software. The program can be downloaded from the R Homepage.

Tcl Install the Tcl/Tk package.

- Use the MacPorts to install the current version.
  From the Terminal window enter "`sudo port install tchsh8.5`"
- Check the install by entering "`tclsh`" and you should see the prompt "`\%`". Enter "`^C`" to quit.

Sharing Certain system sharing packages must be configured. From under the Apple symbol opne "System Preferences" and then, under "Internet & Wireless" open the "Sharing" folder.

- Set the Computer Name to "`isar6`".
- Turn "Screen Sharing" on.
- Under Screen Sharing go to "Computer Settings...", select "VNC viewers may control screen with password:", and set the password to "`isar06`".
- Also set "Allow access for:" to "All users."
- Next, under "Sharing," turn "Remote Login" on and "Allow access for:" set to "All users."

Zterm Install the open source Mac terminal program Zterm.

- We use the UC232A USB to RS232 driver. This is a popular and common piece of essential hardware.
- The UC232A requires a driver which can be found on line. The driver comes as a '.rar' file and requires a rar converter. Download the application UnRarX online.

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C DAQ Setup File

NO.	TAG	DESCRIPTION
16	SST INTERPOLATION CORRECTION	Interpolation value from calibration.
17	CALIBRATION OFFSET	Offset value from calibration.
21	SCAN VIEW ANGLES	Scan angles: BB1, BB2, Sky, Sea. These must agree with the ISAR configuration file.
43	SERIAL HUB URL	Hub IP number on the LAN.
84	GPS HUB COM NUMBER	The hub port number (1-5) plus 10000 for the GPS serial input.

Actually, unless the ISAR position on the ship is moved, only lines 16 & 17 need to be adjusted as a result of calibration.

```
THIS FILE: su06.txt
110809, 0343Z
------- EXPERIMENT SETUP ------------
  This section identifies the experiment and the experiment parameters. The
instrument location,
  and orientation on its platform are identified.
EXPERIMENT NAME: CINDY
GEOGRAPHIC LOCATION: MIRAI INDIAN OCEAN
PLATFORM NAME: MIRAI
LOCATION ON PLATFORM: FOREMAST
HEIGHT ABOVE SEA LEVEL (m): 20 APPROX
SHIP TYPE: M/V
SHIP NAME: MIRAI
CRUISE NAME: K234-6

#Calibration
SST INTERPOLATION CORRECTION : 1.0033
CALIBRATION OFFSET: 0.1085

# Agree with the configuration (.cfg) view angles
 (bb1, bb2, sky, sea)
SCAN VIEW ANGLES: 280 325 35 145


MINIMUM EXPECTED LATITUDE: -90
MAXIMUM EXPECTED LATITUDE: 90
## make longitude in the range 0-360
## we expect the ship to be in the range [min,max] else missing
MINIMUM EXPECTED LONGITUDE: 0
MAXIMUM EXPECTED LONGITUDE: 360

COMMENTS:
  ISAR6 DAQ4 SYSTEM
  Calibration i6_cal_110809
END

---- DATA ACQUISITION PROGRAM PARAMETERS --------
  For testing save data with software. Normally
  data can be saved in an archive folder.
  NOTE: To set this device one can
  use a web browser. Go to the current IP. If you don't know the
  current IP it is easiest to use a Windows PC and VXComm.exe.
  You need to always know the current IP address.
SERIAL HUB URL: 128.20.8.12
SERIAL HUB OFFSET: 10000


---- DATA FILES ---------------------
```

```
  Data are written into a subdirectory under the current
  working directory.  Usually this is called "data."
DATA OUTPUT PATH: data
MISSING VALUE: -999
ISAR-RT OUT PATH: data

---- TCM SETUP ----------------------
  NOTE: Set the tcm for 9600 baud, 1-sec output, NMEA only string.
  $HCHDM,310.0,MP5.4R0.1X7.75Y15.11Z51.87T25.6*2D

  Hub number = 10004
    -1 if no TCM
     0 to simulate,
    '10004' for daq4
TCM HUB COM NUMBER: -1
TCM MODEL NUMBER: GPS17X
TCM SERIAL NUMBER: ???
TCM MIN SAMPLES FOR AVG: 3
TCM AVERAGING TIME: 120
  === FIXED POSITION (Under development) ====
  If HUB = 0 then we can specify exact coordinates for a fixed position.
TCM FIXED PITCH: 47.60329
TCM FIXED ROLL: -122.28797
TCM FIXED AZIMUTH: 18.1

TCM COMMENTS
 We are adding the TCM to the DAQ box.
END

---- GPS SETUP ----------------------
  NOTE: Use the Garmin-supplied Windows program to set the 17x for
  9600 baud, 5-sec output, GPRMC only string.
  Hub number =
    -1 if no GPS, Use fixed values below.
     0 to simulate a GPS,
    '10003' for daq4
GPS HUB COM NUMBER: 10003
GPS MODEL NUMBER: GPS17X
GPS SERIAL NUMBER: ???
GPS MIN SAMPLES FOR AVG: 3
GPS AVERAGING TIME: 120
  === FIXED POSITION (Under development) ====
  If HUB = 0 then we can specify exact coordinates for a fixed position.
GPS FIXED LATITUDE: 47.60329
GPS FIXED LONGITUDE: -122.28797
  Magnetic variation, + = East
GPS FIXED VARIATION: 18.1

```

```
GPS COMMENTS
 The receiver is the GPS17X by Garmin.
END

------ ADAM 4060 SETUP ON PDS752 HUB ------------------
Adam 4060 is a relay switch that controls power to the Isar.
Set the hub address to 10002
485 HUB COM NUMBER: 10002


---- ISAR SETUP --------------------
  0 for simulate.
  10001 connected to hub port x
ISAR HUB COM NUMBER: 10001

ISAR AVERAGING TIME (sec): 600

    #Set up a tty port for logging data real time
TTY OUTPUT: YES

#Which side is the Isar mounted on. PORT or STARBOARD
#Use this to compute actual viewing angle.
PLATFORM SIDE: STARBOARD

# (0,1,...) index.  Use for calibration case
CALIBRATION VIEW : 3

We want to only process certain thermistors.
PROCESSING BB1 THERMISTORS: 1 2
PROCESSING BB2 THERMISTORS: 1 2

---------- ISAR CALIBRATION AND INTERNAL PARAMETERS ----------------
ISAR SERIAL NUMBER: 06

Verbose mode prints out test messages and data.  VERBOSE = 1, NOT VERBOSE = 0
avgisar.pl makes a file called data/tmp.txt.
VERBOSE MODE: 0

#If you want to simulate then name a raw data file.
SIMULATE FILE: simulate/isar.txt

## Specifics on the Instrument
## isar01 : 01, 4832, kt15_filter_15854832.dat, I01V0555.txt
## isar04 : 04, 5339, kt15_filter_15855339.dat, I04V0355.txt
KT15 SERIAL NUMBER: 10200
KT15 FILTER FILE: kt15/kt15_filter_158510200.txt

MISSING VALUE: -999
```

```
144
145 #CAL EMIS: 0 = field use, compute e from angle,  ~=1 = calibration mode
146 CALIBRATION EMISSIVITY: 0
147
148 SEA EMISSIVITY (UNCORRECTED): 0.9870975
149 BLACK BODY EMISSIVITY : 1.0
150 APERATURE EMISSIVITY : 0.95
151
152 ## Determined during calibration.  Adjusts the BB slope.
153 CALIBRATION FILE: i04cal_101013_apl
154
155 ## set Vref to 0 and the values from the 2*adc12-7 will be used.
156 BB THERM VREF: 0
157 BB TEMP Ref R: 10000
158
159 Resistances from testing with precision resistances. See notes 090909.
160 BB RESISTORS: 10000, 10000, 10000, 10000, 10000, 10000
161
162 # Rref for wintemp and tt8temp
163 APPERATURE THERM REF RESISTOR: 10000
164
165 REF VOLTAGE FOR 12 BIT ADC: 4.0928
166 # Rref2 for four ysi apperature therms
167 ## ISAR-01: 9995 9984 9997 9997
168 ## ISAR-04: 10000 10000 10000 10000
169 APPERATURE THERMS REF RESISTANCES: 10000 10000 10000 10000
170
171 RAW FILE RECOGNITION STRING (not case sensitive, recognize a raw data file):
  … ^ISAR5.+\.RAW$
172 MAXIMUM NUMBER OF AVERAGES (Set to 1e20 for final run) : 1e20
173 MIN SAMPLES FOR AVG: 2
174 SELF-HEAT FLAG: 1
175
176
177 ---- SBD SETUP ---------------------
178   The sbd is connected to port 10003.
179   If the RAD is not connected enter '0'
180   0 Simulate
181   1000x connected
182 SBD HUB COM NUMBER: 0
183 SBD MODEL NUMBER: NAL_9601-D
184   The serial number is written on the circuit board.
185   UMiami unit = 300034012200640
186 SBD SERIAL NUMBER: 0
187
188 ## If you want to simulate SBD modem the say 'YES'
189 ## For standard processing with a real modem say 'NO'
190 SBD SIMULATE FLAG: NO
```

```
191
192 Set the SBD data TX time.
193 When the time since the last tx > sbdsecs we transmit.
194 SBD TX TIME SECS: 1700
195
196 Time in secs to wait before recording no data.
197 SBD error messages at this rate.
198 Typically 3600
199 NO DATA WAIT TIME: 3600
200
201 SBD COMMENTS:
202   Iridium SBD unit for DAQ4
203   There is no modem in daq4 at this time.
204 END
205
206
207 END SETUP FILE
208
```

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D ISAR Configuration File

At startup the ISAR reads an internal configuration file named
`~/isar/software/isarconf.cfg`
which is refered to here as the “config” file.

IMPORTANT OPERATIONAL LINES

NO.	TAG	DESCRIPTION
52	SCAN_POS_3	Set the Sky view angle (35) and the number of sample to take (10)
53	SCAN_POS_4	Set the Sea view view angle (145) and the number of sample to take (40)

```
#
######### ISAR configuration file for isar linux v2.x.x code base
######### General format: # comment followed by 1 line data (KEYWORD=DATA)
######### DO NOT DELETE ANY LINES FROM THIS FILE
#
#########
######### 2011-06-08: W Wimmer Version 2.0.0, Revision 1
#
################### Contact information ####################
#
#### Title for this deployment/configuration stating purpose of this isarconf
… file (str[255])
TITLE=ISAR6 OPERATION ON MIRAI, 110809
#### ICF author name, e-mail and telephone number (str[255])
AUTHOR=M. Reynolds
EMAIL=michael@rmrco.com
PHONE=+1 206 701 6659
#### Last Edit date of this icf file yyyy-mm-dd (str[15])
EDITDATE=2011-08-10
#
LOGFILE_PATH=/data/
################### General instrument configuration ###############
#
#### ISAR-5D serial number (int)
ISARID=6
#### Date and details of last ISAR-5D instrument calibration date (str[255])
CALDATE=Expected bath on Mirai 110809
#### USER FLAGS: 1=condition set; 0=condition not set.
# LOG_DATA - log to flashcard; CALC_SST - compute SSTskin; START_DIAGN -
… diagnostic data at boot; RAW_PNI - output onboard compass data;
# RAW_GPS - output onboard GPS data; MEAN_REC - output $IS5MR data record;
… CAL_REC - output $I5CAL record; XTEMP - run BB crossing temperature routine;
# ROLL_PITCH_STOP - shutdown ISAR if roll or pitch limits exceeded; FREEZING -
… shutdown ISAR if ambient temp falls below 273.15K;
# ORG_WARMING - wait 30 measurement cycles before measurement loops starts
# For more details see manual section 7.x
LOG_DATA=1
CALC_SST=0
START_DIAGN=0
RAW_PNI=0
RAW_GPS=0
MEAN_REC=0
CAL_REC=1
XTEMP=0
ROLL_PITCH_STOP=0
FREEZING=0
ORG_WARMING=1
#### Number of cycles (n) to wait after rain event has finished (time is ~n*2
```

```
44… secs.  Lab=60 Field= ~350) (int)
 45 ORG_OPEN_DELAY=100
 46 #### Number of scan samples when closed on BB1 & BB2
 47 ORG_SCAN_SAMPLES=500
 48 #### Configure ISAR measurement angles (angle in degrees, number of samples). Up
  … to 10 positions can be sequentially set.
 49 # Angles 280.0 & 325.0 must be set for BB on position 1 and 2.
 50 SCAN_POS_1=280.0,30
 51 SCAN_POS_2=325.0,30
 52 SCAN_POS_3=35.0,10
 53 SCAN_POS_4=145.0,40
 54 #### Defining variables that will be used to calculate SSTskin temperature;
 55 # SEAVIEW_POS - seaview scandrum position; SKYVIEW_POS - skyview scandrum
  … position; EMISSIVITY - seawater emissivity; RMR_CORR - RMR x correction factor;
 56 # VREF - reference voltage (0 if using internal voltage); RREF - reference
  … resistance;
 57 #INTBB_EMISSIVITY - internal BB emissivity; SELFHEAT_CORR - self heating
  … correction on/off;
 58 SEAVIEW_POS=3
 59 SKYVIEW_POS=2
 60 EMISSIVITY=0.991635
 61 RMR_CORR=1.0
 62 VREF=0.0
 63 RREF=10000.0
 64 INTBB_EMISIVITY=0.9993
 65 SELFHEAT_CORR=0
 66 #### Heated (Active) blackbody (1 or 2; Normally 2 unless changed by user)
 67 HOTBB=2
 68 #
 69 ################### External RS485 configuration ###############
 70 #
 71 #### Up to 8 External RS485 devices can be sequentially defined.
 72 # RS485_n_NAME - label for device; RS485_n_ADDRESS - RS485 address;
  … RS485_n_COMMAND - device specific read command;
 73 #RS485_1_NAME=RhoPD_D1102_CM11_Solarimeter,
 74 #RS485_1_ADDRESS=4
 75 #RS485_1_COMMAND=$4RD
 76 #
 77 #RS485_2_NAME=RhoPD_D1102_PIR_Eppley
 78 #RS485_2_ADDRESS=T
 79 #RS485_2_COMMAND=$TRD
 80 #
 81 #RS485_3_NAME=RhoPD_D5132_PIR_Eppley
 82 #RS485_3_ADDRESS=U
 83 #RS485_3_COMMAND=$URB
 84 #
 85 #RS485_4_NAME=RhoPD_D5112_PAR
 86 #RS485_4_ADDRESS=A
```

```
#RS485_4_COMMAND=$ARD
#
#RS485_5_NAME=AD_Converter
#RS485_5_ADDRESS=01
#RS485_5_COMMAND=#01
################### PNI compass configuration ###############
#
#### PNI sensor pitch warning limit (deg) (float)
PITCH_LIMIT=20.0
#### PNI sensor roll warning limit  (deg) (float)
ROLL_LIMIT=20.0
#### PNI compass serial number (str[80])
PNI_SN=9824_(v2.82)
#
################### ORG configuration ###############
#
#### Optical rain guage serial number (str[80])
ORG_SN=0508501
#### SCTI Optical rain guage description (str[128])
ORG_MODEL=Thies 5.4103.20.041
#### Optical rain guage rain voltage threshold below which shutter is closed
… (float). Lab=1.0, Field= ~0.054
ORG_MEAN_LIMIT=1.5
#### Optical rain guage rain voltage standard deviation above which shutter is
… closed (float). Lab=1.0, Field= ~0.002
ORG_SD_LIMIT=0.25
#### ORG history (str[128])
ORG_COMMENT=new model
#
################### A2 Encoder configuration ###############
#
#### US-DIGITAL A2 Encoder serial number (str[80])
ENCODER_SN=21363
#### A2 encoder reference position (float,deg)
ENCODER_REF=0.0
#### A2 encoder park angle (normally over lower blackbody) (float,deg)
ENCODER_PARK=280.0
ENCODER_BAUD=9600
ENCODER_RESOLUTION=14400
#
################### Optical component configuration ###############
#
#### ISAR-5D mirror serial number (str[80])
MIRROR_SN=OFR-MR-25-20 (2011-05-30)
#### ISAR-5D window serial number (str[80])
WINDOW_SN=CRYSRTAN-ZNSE bbar batch 24827 (2011-07-22)
#
########################## Motor configuration ##################
```

```
133 #
134 #### ISAR-5D scan drum drive motor and gearbox serial number (str[80])
135 SCAN_MOTOR=MAXON-A-Max 110926 Installed on: 2011-04-21
136 #### ISAR-5D shutter drive motor and gearbox serial number (str[80])
137 SHUTTER_MOTOR=MAXON-A-Max 110926 Installed on: 2011-04-21
138 #
139 ########################## GPS configuration ###################
140 #
141 #### Trimble GPS board serial number (str[80])
142 GPS_SN=85843798 (Lassen SK8)
143 GPS_BAUD=4800
144 #
145 ########################## KT15 configuration DO NOT ALTER !!###################
146 #
147 #### KT15.85D Serial number (int)
148 KT15_SN=10200
149 #### Date and details of KT15.85D last calibration (str[255])
150 KT15_CAL=2010-27-11, Polynomials for R2T & T2R: TJ Nightingale
151 #### KT15 emissivity setting command (0.001 -> 1.000) (str[15])
152 KT15_CMD_EMISIVITY=EPS 1.000
153 #### KT15 response setting command (0.05, 0.1, 0.3, 1 3 or 10 seconds) (str[15])
154 KT15_CMD_RESP=RESP 1.0
155 #### KT15 analog output setting command (DO NOT ALTER WITHOUT CONSIDERATION TO
  … CONSEQUENCES) (str[30])
156 KT15_CMD_ANALOG=ANALOG -100.0 50.0 C 3
157 #### KT15 serial interface setting (DO NOT ALTER WITHOUT CONSIDERATION TO
  … CONSEQUENCES) (str[20])
158 KT15_CMD_SERIAL=COM 96 8 1 n
159 #### KT15 Temperature to Radiance coefficients based on kt15 filter response (-1
  … not used) (double[9])
160 KT15_COEFF_T2R=-22.925646e0,65.196703e0,-81.215855e0,56.792568e0,-21.105313e0,3.
  … 2575460e0,-1.0,-1.0,-1.0
161 #### Radiance to Temperature coefficients based on kt15 filter response (-1 not
  … used) (double[9])
162 KT15_COEFF_R2T=273.15973e0,54.529628e0,10.634341e0,2.0172007e0,3.6480705e-1,5.
  … 7776974e-2,6.5293295e-3,3.5814663e-4,-1.0
163 #
164 ########################## Electronics configuration DO NOT ALTER
  … !!###################
165 #### CPU BOARD
166 CPU_BOARD_DESC=ARCOM TITAN
167 CPU_BOARD_SN=2
168 #### COM BOARD
169 COM_BOARD_DESC=DIAMOND SYSTEMS EMM
170 COM_BOARD_SN=2
171 #### AD BOARD
172 AD_BOARD_DESC=DIAMOND SYSTEM DMM
173 AD_BOARD_SN=2
```

```
174 #### POWER BOARD
175 POWER_BOARD_DESC=NOCS
176 POWER_BOARD_SN=P2-RevB
177 #### THERM BOARD
178 THERM_BOARD_DESC=NOCS
179 THERM_BOARD_SN=T2-RevB
180 #### Serial number of CFCard (char[10]) e.g., SOC001
181 FLASHCARD=NOC005F
182 #
183 ########################## Black body #1 configuration ###################
184 #
185 #### BB1 serial number (int)
186 BB1_SN=11
187 #### BB1 description (str[128])
188 BB1_DESC=See ISAR-BB-Configuration.doc for history
189 #### BB1 thermistor 1 serial number (str[80])
190 BB1_THERM1_SN=ISAR-TH10-11032
191 #### BB1 Thermistor 1 description (str[128])
192 BB1_THERM1_DESC=YSI NASA grade 46041 0.05K intercahngable thermistor with
  … standard YSI calibration
193 #### BB1 Thermistor 1 calibration coeficients: Range 268.16 ->338.16K, -1.0 not
  … used(double[10])
194 BB1_THERM1_COEFF=1.0271173e-3, 2.3947051e-4,
  … 1.5532990e-7,-1.0,-1.0,-1.0,-1.0,-1.0,-1.0,-1.0
195 #### BB1 thermistor 2 serial number (str[80])
196 BB1_THERM2_SN=ISAR-TH11-11032
197 #### BB1 Thermistor 2 description (str[128])
198 BB1_THERM2_DESC=YSI NASA grade 46041 0.05K intercahngable thermistor with
  … standard YSI calibration
199 #### BB1 Thermistor 2 calibration coeficients: Range 268.16 ->338.16K, -1.0 not
  … used(double[10])
200 BB1_THERM2_COEFF=1.0271173e-3, 2.3947051e-4,
  … 1.5532990e-7,-1.0,-1.0,-1.0,-1.0,-1.0,-1.0,-1.0
201 #### BB1 thermistor 3 serial number (str[80])
202 BB1_THERM3_SN=ISAR-TH12-11032
203 #### BB1 Thermistor 3 description (str[128])
204 BB1_THERM3_DESC=YSI NASA grade 46041 0.05K intercahngable thermistor with
  … standard YSI calibration
205 #### BB1 Thermistor 3 calibration coeficients: Range 268.16 ->338.16K, -1.0 not
  … used(double[10])
206 BB1_THERM3_COEFF=1.0271173e-3, 2.3947051e-4,
  … 1.5532990e-7,-1.0,-1.0,-1.0,-1.0,-1.0,-1.0,-1.0
207 #
208 ########################## Black body #2 configuration ###################
209 #
210 #### BB2 serial number (int)
211 BB2_SN=12
212 #### BB2 description (str[128])
```

```
BB2_DESC=See ISAR-BB-Configuration.doc for history
#### BB2 thermistor 1 seriall number (str[80])
BB2_THERM1_SN=ISAR-TH04-11032
#### BB2 Thermistor 1 description (str[128])
BB2_THERM1_DESC=YSI NASA grade 46041 0.05K intercahngable thermistor with
… standard YSI calibration
#### BB2 Thermistor 1 calibration coeficients: Range 268.16 ->338.16K, -1.0 not
… used(double[10])
BB2_THERM1_COEFF=1.0271173e-3, 2.3947051e-4,
… 1.5532990e-7,-1.0,-1.0,-1.0,-1.0,-1.0,-1.0,-1.0
#### BB2 thermistor 2 serial number (str[80])
BB2_THERM2_SN=ISAR-TH05-11032
#### BB2 Thermistor 2 description (str[128])
BB2_THERM2_DESC=YSI NASA grade 46041 0.05K intercahngable thermistor with
… standard YSI calibration
#### BB2 Thermistor 2 calibration coeficients: Range 268.16 ->338.16K, -1.0 not
… used(double[10])
BB2_THERM2_COEFF=1.0271173e-3, 2.3947051e-4,
… 1.5532990e-7,-1.0,-1.0,-1.0,-1.0,-1.0,-1.0,-1.0
#### BB2 thermistor 3 serial number (str[80])
BB2_THERM3_SN=ISAR-TH06-11032
#### BB2 Thermistor 3 description (str[128])
BB2_THERM3_DESC=YSI NASA grade 46041 0.05K intercahngable thermistor with
… standard YSI calibration
#### BB2 Thermistor 3 calibration coeficients Range 268.16 ->338.16K, -1.0 not
… used(double[10])
BB2_THERM3_COEFF=1.0271173e-3, 2.3947051e-4,
… 1.5532990e-7,-1.0,-1.0,-1.0,-1.0,-1.0,-1.0,-1.0
#
########################## Instrument Thermistor configuration
… ###################
#
#### Window thermistor serial number (str[80])
WINDOW_THERM_SN=LOT:04A0423
#### Window thermistor description (str[128])
WINDOW_THERM_DESC=Window; YSI NASA grade 46041 0.05K interchangable thermistor
… with standard YSI calibration
#### Window thermistor calibration coeficients: Range 268.16 ->338.16K, -1.0 not
… used(double[10])
WINDOW_THERM_COEF=1.0271173e-3, 2.3947051e-4,
… 1.5532990e-7,-1.0,-1.0,-1.0,-1.0,-1.0,-1.0,-1.0
#### Channel A thermistor serial number (str[80])
THERM_A_SN=LOT:04A0423
#### Channel A thermistor description (str[128])
THERM_A_DESC=Channel A; YSI NASA grade 46041 0.05K interchangable thermistor with
… standard YSI calibration
#### Channel A thermistor calibration coeficients: Range 268.16 ->338.16K, -1.0
… not used(double[10])
```

```
246 THERM_A_COEF=1.0271173e-3, 2.3947051e-4,
  … 1.5532990e-7,-1.0,-1.0,-1.0,-1.0,-1.0,-1.0,-1.0
247 #### Channel B thermistor serial number (str[80])
248 THERM_B_SN=LOT:04A0423
249 #### Channel B thermistor description (str[128])
250 THERM_B_DESC=THERM_A_SN=Channel B; YSI NASA grade 46041 0.05K interchangable
  … thermistor with standard YSI calibration
251 #### Channel B thermistor calibration coeficients: Range 268.16 ->338.16K, -1.0
  … not used(double[10])
252 THERM_B_COEF=1.0271173e-3, 2.3947051e-4,
  … 1.5532990e-7,-1.0,-1.0,-1.0,-1.0,-1.0,-1.0,-1.0
253 #### Channel C thermistor serial number (str[80])
254 THERM_C_SN=LOT:04A0423
255 #### Channel C thermistor description (str[128])
256 THERM_C_DESC=Channel C; YSI NASA grade 46041 0.05K interchangable thermistor with
  … standard YSI calibration
257 #### Channel C thermistor calibration coeficients: Range 268.16 ->338.16K, -1.0
  … not used(double[10])
258 THERM_C_COEF=1.0271173e-3, 2.3947051e-4,
  … 1.5532990e-7,-1.0,-1.0,-1.0,-1.0,-1.0,-1.0,-1.0
259 #### Channel D thermistor serial number (str[80])
260 THERM_D_SN=LOT:04A0423 # KT15 !!!
261 #### Channel D thermistor description (str[128])
262 THERM_D_DESC=Channel D; YSI NASA grade 46041 0.05K interchangable thermistor with
  … standard YSI calibration
263 #### Channel D thermistor
264 THERM_D_COEF=1.0271173e-3, 2.3947051e-4,
  … 1.5532990e-7,-1.0,-1.0,-1.0,-1.0,-1.0,-1.0,-1.0
265 #
266 ######################### EOF ######################################
267
```

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E BASHRC Unix Setup File

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The DAQ software makes much use of the `>bashrc` setup file. A set of alias commands and environmental variables are used for the software.

```
 1
 2 export PS1='\w/$ '
 3
 4 # ~/.bashrc
 5 # executed by login and subshells
 6
 7 alias myalias='less ~/.bashrc'
 8
 9
10
11 #====== ISAR ============================================================
12
13 # The path might be to the mem stick. "/Volumes/TD04/ISAR"    "$HOME/ISAR"
14 export ISARFOLDER="/Volumes/TD04/ISAR"
15
16 # NETWORK
17 export IPPC="128.20.8.10"
18 export IPISAR="128.20.8.11"
19 export IPHUB="128.20.8.12"
20 export IPIBOOT="128.20.8.13"
21 export IPCAL="128.20.8.14"
22 export MYMASK="255.255.0.0"
23 export MYGATEWAY="128.20.1.240"
24 export MYDNS="128.20.1.1"
25
26 # PERL LIBRARY
27 export MYLIB=$ISARFOLDER"/tools"
28 export MYDATAPATH=$ISARFOLDER"/data"
29 export MYDAQPATH=$ISARFOLDER"/isardaq4"
30
31 # SETUP FILE NAME
32 # 'c' is a calibrate version
33 export SETUPFILE=$MYDAQPATH"/setup/su06.txt"
34 export SETUPCALFILE=$MYDAQPATH"/setup/su06c.txt"
35 export RUNSETUPFILE=$SETUPFILE;
36
37 # PATH CALLS
38 isarpath=$MYDAQPATH
39 alias gtisar='cd $isarpath'
40 alias gtdaq4='cd $isarpath'
41
42 # SETUP EDIT CALLS
43 # BACKUP SETUP
44 alias BUsu="cp $SETUPFILE $SETUPFILE.bu"
45 alias EDsu='open -a BBEdit.app $SETUPFILE'
46 alias edsu='cd $isarpath; ./ChangeSetup.pl'
47 alias EDsuc='open -a BBEdit.app $SETUPCALFILE'
48 alias edsuc='cd $isarpath; ./ChangeCalSetup.pl'
```

```
 49
 50 # START CALLS
 51 alias START="cd $isarpath; ./PrepareForRun.pl; export RUNSETUPFILE=\`cat tmp\`"
 52 alias STARTCAL="cd $isarpath;  ./PrepareCalRun.pl; export RUNSETUPCALFILE=\`cat tm
 53
 54 # RUN CALLS
 55 alias G='cd $isarpath;  ./G.ex $RUNSETUPFILE'
 56 alias Gc='cd $isarpath; ./Gc.ex $RUNSETUPCALFILE'
 57
 58 # EXPORT
 59 alias Export="cd $MYDATAPATH; perl $MYDAQPATH/TarDataSet.pl;"
 60
 61 # PROCESS CALIBRATION
 62 #alias ProcCal="cd $isarpath/proc_cal; ./0_ProcCal.sh; export PROCCALPATH=`cat tmp
 63
 64 # TEST CALLS
 65 alias I='cd $isarpath;  ./term_to_isar.ex $SETUPFILE'
 66 alias Ic='cd $isarpath;     ./term_to_isar.ex $SETUPCALFILE'
 67 alias N='cd $isarpath;  ./term_to_nal.ex  $SETUPFILE'
 68 alias P='cd $isarpath;  ./term_to_gps.ex  $SETUPFILE'
 69 alias B='cd $isarpath;  ./term_to_bath.ex  $SETUPCALFILE'
 70
 71 alias iBoot="Safari http://192.168.1.2"
 72 alias IsarOn="cd $isarpath;     ./IsarPwr.ex $Setup ON"
 73 alias IsarOff="cd $isarpath;    ./IsarPwr.ex $Setup OFF"
 74 alias IsarCycle="cd $isarpath;  ./IsarPwr.ex $Setup CYCLE"
 75 alias IsarState="cd $isarpath;  ./IsarPwr.ex $Setup state"
 76
 77 alias PingHub="ping $IPHUB"
 78 alias PingiBoot="ping $IPIBOOT"
 79 alias PingCal="ping IPCAL"
 80 alias PingIsar="ping $IPISAR"
 81 alias PingMe="ping $IPPC"
 82
 83 #============================================================================
 84
 85
 86 # RUN APPS
 87 alias Safari='open -a Safari'
 88 alias Bbedit='open -a /Applications/BBEdit.app'
 89 alias me='Bbedit'
 90 alias Finder='open -a Finder.app '
 91 alias Finder4='open -a Finder.app $isarpath'
 92
 93 ## HELP FILES
 94 alias mh='less ~/swmain/Unix/myhelp/myhelp_general'
 95
 96 # EDIT HELP FILES
```

```
 97 alias rcedit='me ~/.bashrc'
 98
 99 # UTILITIES
100 alias ll='ls -ltF'
101 alias shutdn='expect ~/swmain/expect/misc/Shutdown.ex'
102 alias reboot='expect ~/swmain/expect/misc/Reboot.ex'
103 alias Top="top -u -s5"
104 alias Ps="ps -axrf | more"
105
106
107 # NOTE FILES
108 #notepath='/Volumes/mike6440/RMRCO/NOTES';
109 #alias isar6notes="cd /Volumes/mike6440/RMRCO/PRODUCTS/isar6_system; echo --------
110
111
```

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F Miscellaneous Problems and Procedures

F.1 Shutter Gear Runs Off the End of the Belt

There is a gap between the shutter belt and the rubber stopper. Sometimes, by accident, the shutter is run too far and the gear moves into the gap. Then the gear spins.

Solution. When the gear is turning, move the shutter by hand so it engages the belt. Actually this should not happen in normal operation. In test mode it is possible to run the motor until this occurs.

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G Software Overview

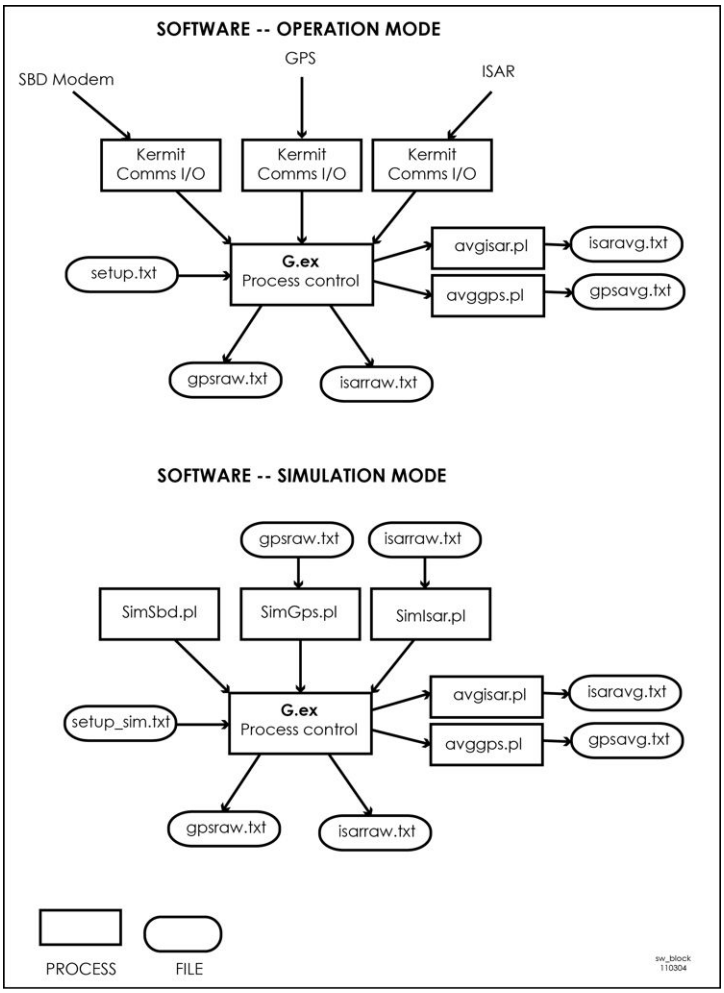

Figure 17: Software block diagram.

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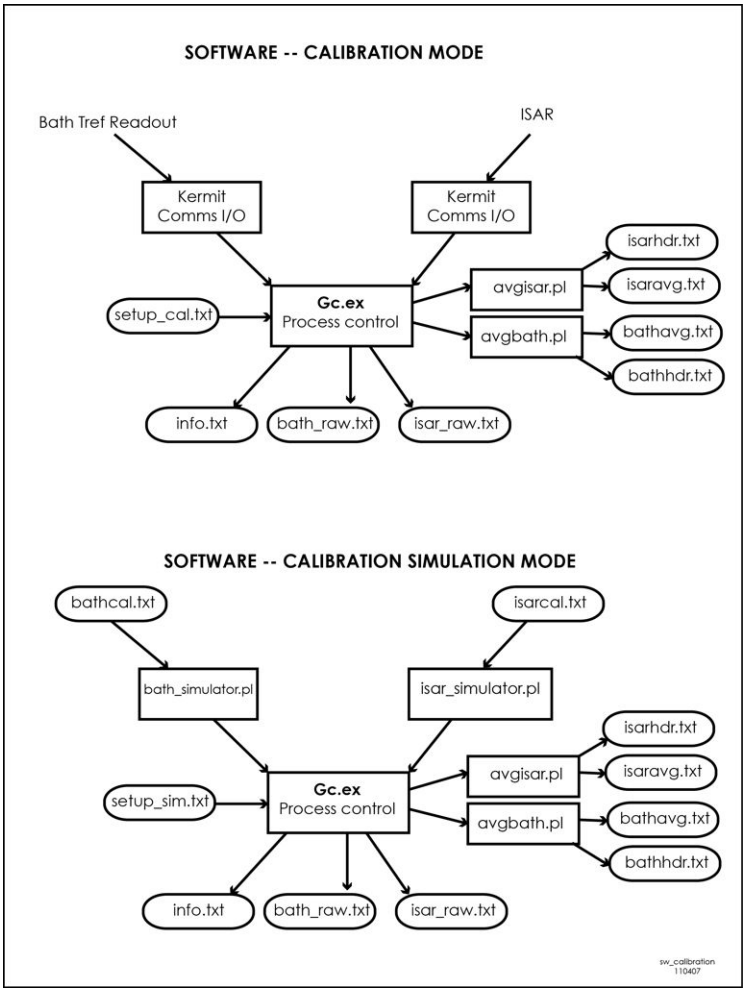

Figure 18: Calibration Software block diagram.

H Glossary

ASCII The American Standard Code for Information Interchange is a character-encoding scheme based on the ordering of the English alphabet. The same as a 'text' file.

CASOTS The portable water bath calibration system developed by SOES.

CLIENT/SERVER Client/server describes the relationship between two computer programs in which one program, the client, makes a service request from another program, the server, which fulfills the request. Although the client/server idea can be used by programs within a single computer, it is a more important idea in a network.

DAQ4 The data acquisition hardware and software developed by RMR Co. to support installation of ISAR6 and provide computed SSST to local data collection.

DIN DIN is an acronym for Deutsche Institute fuer Normung, a German standardization body and member of the International Standards Organization (ISO). DIN rails and mounting hardware are standard mounting equipment for a variety of electronic components, including terminal blocks to connect wiring. DIN rails and DIN mounting hardware are internationally approved, industry standard hardware for a vast array of components made by computer manufacturers. DIN rail terminal blocks also offer grounding and disconnecting capability and provide self-locking clamps to ensure a tight connection.

DIN Rail A DIN rail is a metal rail of a standard type widely used for mounting circuit breakers and industrial control equipment inside equipment racks. The term applies to multiple similar standards.

EXPECT Expect is a Unix automation and testing tool, written by Don Libes as an extension to the Tcl scripting language, for interactive applications such as telnet, ftp, passwd, fsck, rlogin, tip, ssh, and others. It uses Unix pseudo terminals to wrap up subprocesses transparently, allowing the automation of arbitrary applications that are accessed over a terminal.

HUB A HUB in the DAQ is a device that concentrates several serial communication lines (RS232, RS422, RS485) into a single Ethernet IP port.

ISAR Infrared Seasurface Temperature Autonomous Radiometer (ISAR)

ISAR6 The particular ISAR system introduced after ISAR SN# 6.

KERMIT Kermit software offers interactive and scripted file transfer and management, terminal emulation, Unicode-aware character-set conversion, and/or Internet security

MATLAB Matlab is a numerical computing environment and fourth-generation programming language. Developed by MathWorks, MATLAB allows matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces, and interfacing with programs written in other languages, including C, C++, and Fortran.

MODEM The "modem" is an interface to the Iridium SBD data system. The DAQ4 has all connectors and software to add the NAL 9602 modem.

NIST The National Institute of Standards and Technology (NIST), known between 1901 and 1988 as the National Bureau of Standards (NBS), is a measurement standards laboratory which is a non-regulatory agency of the United States Department of Commerce.

PERL Perl is a high-level, general-purpose, interpreted, dynamic programming language. Since it was developed in the mid-eightys, it has undergone many changes and revisions and become widely popular amongst programmers. The language provides powerful text processing facilities without the arbitrary data length limits of many contemporary Unix tools, facilitating easy manipulation of text files.

RU The RU is the remote Unit of the DAQ4. It is located in an unsheltered area close to the ISAR and provides an interface between the ISAR and the User Interface (UI).

SBD

SETUP FILE

SOES Southampton Ocean and Environment School. The company that makes the ISAR.

SSST Sea surface skin temperature. The temperature of the, approximately, 10μm of the ocean surface.

SWITCH A network switch or switching hub is a computer networking device that connects network segments.

UI The User Interface (UI) is the part of the DAQ4 that controls the RU, collects and processes data, and computes SSST for the data system.

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References

Donlon, C., I. Robinson, M. Reynolds, W. Wimmer, G. Fisher, R. Edwards, and T. Nightingale, An infrared sea surface temperature autonomous radiometer (isar) for deployment aboard volunteer observing ships (vos)), *Journal of Atmospheric and Oceanic Technology*, *25*(1), 93–113, 2008.

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